NOTES.

A MEMORIAL edition of the scientific writings of the late Prof. G. F. FitzGerald, F.R.S., will shortly be published in the Dublin University Press series. The volume has been prepared under the editorial supervision of Dr. J. Larmor, F.R.S., and footnotes in elucidation or correction of the text have been added where necessary. It extends to about 570 octavo pages, together with 64 pages of an introduction, in part biographical and in part historical and explanatory, of Prof. FitzGerald's relation to contemporary science. As much of his stimulating and suggestive thought was published in journals not readily accessible, just as it flowed from his pen, this substantial collection of papers will in the main be fresh to physicists. Being a record of the activity of a mind that was always in the van of progress, it will also be of interest as a reminder of the paths of advance of physical science during the last quarter of a century.

IT is beginning to be recognised that scientific knowledge, and a progressive frame of mind are attributes which must be possessed by all who are preparing for the struggle of the future, whether in peace or war. In the debate upon the Navy Estimates in the House of Commons on Friday, the scientific aspect of the problem of naval warfare was mentioned, and we are glad to see that Mr. Arnold Forster referred to the importance of keeping it in mind. As to the part science ought to play, and the respect it ought to receive in the Navy, he remarked that he believed it to be true of the Navy, as of every large department, that we had not yet fully realised the position that science had taken, and was bound to take to a still larger extent, in this country and in the world. He did not know that that was peculiar to the Navy. He thought it was far less true of the Navy than it was of many other great departments of life.

AT the general meeting of the Zoological Society of London held on June 19, the gold medal of the Society was delivered by His Grace the Duke of Bedford, K.G., president, to Sir Harry Johnston, G.C.M.G., K.C.B., in consideration of his great services to zoological science while occupying various official posts in Africa and especially in commemoration of his discovery of the okapi. After the close of the meeting, the third of the series of zoological lectures for the present year was delivered by Prof. E. Ray Lankester, F.R.S., on the okapi and its position in the natural series. Prof. Lankester's memoir in the Society's *Transactions*, which contains a full account of all that is known of "the new African mammal" up to the present date, is expected to be ready very shortly.

THE annual general meeting of the Röntgen Society will be held on Thursday, July 3.

IN connection with the Egypt Exploration Fund, an exhibition of antiquities found by Prof. Petrie at Abydos, and by Dr. B. P. Grenfell and Dr. A. S. Hunt in the Fayum and El Hibeh, will be on view at University College from July 1 to July 26.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on July 1. There will be a reception of the foreign delegates to the International Tramways and Light Railways Congress at 9.15 p.m.

SINCE May 3, 1832, when Louis Bonaparte, then President of the French Republic, decreed that the Pantheon was again to be considered a Roman Catholic Church, the great pendulum installed by Léon Foucault to afford a proof of the rotation of the earth has been laid aside. M. de Fonvielle informs us that workmen are now busy making preparation for a new series of demonstrations. The operations will be conducted under the supervision of M. Berget, assistant to M. Poincaré. The pendulum itself is a ball of lead weighing 27 kilogrammes, and was used in 1869 by M. Maumenée for observations in the cathedral of Rheims during several months. The new demonstrations at Paris will be given in a few days.

THE United States Senate has passed a Bill directing the President to purchase all the capital stock, concession, unfinished work and machinery, and other property of the Panama Canal Company for 8,000,000*l*. The President is further directed to acquire from the Republic of Colombia a strip of land six miles wide along the route, over which the United States shall have permanent control. The Bill next authorises the completion of the canal. If the Panama Company is unable to give a satisfactory title and Colombia refuses to cede the land, the President is authorised to construct a canal by the Nicaragua route. The *Daily Mail* states that since the Martinique disaster the supporters of the Panama Canal have persistently declared that the Nicaragua route passed through a volcanic country, and that the canal would be liable at any moment to be destroyed. This argument had a marked influence in gaining votes for Panama. The passage of the Bill does not end the canal controversy. The House of Representatives recently passed a Bill authorising the construction of a Nicaragua Canal, with only two dissenting votes, but it is believed that the Senate's decision in favour of Panama will now be accepted.

MR. F. FINN writes to us from the Indian Museum, Calcutta, with reference to the late Prof. V. Ball's identification of the Catreus of Ælian with the Himalayan monal-pheasant. This identification Mr. Finn regards as erroneous, and he adduces reasons for considering the Honduras wild turkey as the bird in question. Possibly specimens of this bird may have been obtained in Ælian's time by the natives of Hindustan from America by way of China. If, however, this explanation will not hold good, the somewhat startling theory is suggested that the Honduras turkey was once a native of India.

IN the U.S. *Monthly Weather Review* for January and February last, Mr. A. Matthews discusses at considerable length the term "Indian summer," and gives references to, and quotations from, numerous works relating to its use. In America this season is connected both by name and popular belief with the aborigines; but the term is said to date only from about the last decade of the eighteenth century, and has reference to a spell of warm weather occurring in the late autumn. The term appears to have reached Canada in 1821 and this country in 1830. This warm period is frequently referred to in meteorological text-books; Dr. Buchan points out that if easterly winds have largely predominated in autumn, and south-westerly winds begin to prevail at the end of November, or a little later, the weather is likely to continue exceptionally mild. These conditions occur nearly every year, and the beginning of the warm spell is popularly known in this country as St. Martin's summer.

THE *Agricultural News* of the West Indian Agricultural Department adopts a suggestion that Coronation day, should be marked throughout the islands as an arbor day. It points out that this is exactly the right season for planting purposes. In many localities the planting of ornamental shade trees would be of great public benefit, and at the same time add to the comfort and amenities of life in the tropics. Particulars are given as to the methods of planting, suitable trees and palms for the purpose being always obtainable at the Botanic Gardens.

In connection with the abnormally cold weather which has prevailed over the British Isles, and to a great extent over Western Europe also, since the closing days of April, considerable interest attaches to the temperature of the surface water of the Atlantic during the month of April. The mean results, derived from a total of 4150 observations, are given on the pilot chart for June, just issued by the Meteorological Office. There appears to have been an almost complete absence of ice about the banks of Newfoundland, a fact which is emphasised by the sea water of that region being warmer than usual, the excess ranging upwards to as much as 6° in places. Westward of the thirty-fifth meridian, from 30° to 35° N., the temperature was also rather above the normal, but from the coast of Virginia eastward between these relatively warm patches, along what may be described, roughly, as the Gulf Stream course, there was a deficiency of temperature right across the ocean to our coasts, the eastern half of the Atlantic being below the average. Northward of the fiftieth parallel it would appear that there are no normals available for comparison with the present series, which is unfortunate, as the condition of the sea immediately to the west of our islands, between the Fastnet and Iceland, probably exercises an appreciable influence on our climate. Down to June 16, when the pilot chart went to press, there were still no ice reports of any importance on the banks, the latest being May 8, a piece of ice 4 feet square, one of May 5 relating to bergs stranded on the Newfoundland coast, north of Cape Race. The strait of Belle Isle was clear, but floes were drifting down the Labrador coast, so that steamers could not approach the strait from seaward. Iceland reports show that there has been a good deal of ice off the north-western part of the island.

The result of an investigation by Mr. Maxwell Hall relative to the mean maximum temperature and the rainfall of Jamaica and sunspot frequency has recently been published officially at Jamaica, and has already been mentioned in these columns (p. 159). The temperature observations, a full account of which he gives in the paper, extend over the years 1881 to 1898, and to eliminate minor irregularities Mr. Hall employs for the yearly value the mean of the year and the means of the year each side of this middle year; thus, to take an example, the value for 1885 is the mean for the three years 1884, 1885 and 1886. The temperature variations found in this manner, when compared with the variation in the spotted area of the sun's surface, bring out a close relationship between these two phenomena. Thus it is observed that the temperature is at a maximum at sunspot minimum and *vice versâ*, and that this variation amounts to about 2° F. With regard to the variation of rainfall as deduced from a discussion of the yearly means of rainfall, Mr. Maxwell Hall has previously shown (Nature, vol. xlix. p. 399) that up to the year 1887 there was a general resemblance between the sunspot curve and that of rainfall, the maxima and minima of the rainfall variations corresponding approximately with those of the curve representing the sun's spotted area, but there were certain irregularities which suggested that the old view that there was most rain at the maximum and least at the minimum of the eleven-year curve was only approximately true. The further discussion of the rainfall observations up to the year 1899 shows, however, that this apparent law breaks down completely. When in 1889 and 1890 the rainfall curve should have been at a minimum, in reality it showed a subsidiary maximum, while also when at the sunspot maximum of 1893-4 the rainfall should have been excessive, it was conspicuous by a great deficiency.

The important aid that photography can render to the surveyor has recently been well illustrated by a paper read before the Institution of Mining Engineers by Mr. Arthur O. Wheeler, attached to the staff of the Canadian Topographical Survey. In this paper we have the actual experience of one who has been much engaged in practical surveying, and his notes having reference to the selection of stations and to the photographic processes necessary in the field are as valuable as those which deal with the after manipulation of the photographic enlargements and the production of the contour maps. The application of the photographic method is based on the consideration of the triangle, the angles at the base of which are formed by lines drawn from the two known stations, at which the perspective view of the country has been obtained in the camera, to the point which is to be projected, and which may be considered the apex of the triangle. Accuracy demands that the triangle should be well conditioned, and reaches its highest value when the angle at the apex approaches a right angle. There will be difficulties connected with the selection of suitable stations, difficulties in the identification of orientation points, which Mr. Wheeler makes no attempt to minimise, but a peculiar feature of the method is that it is best adapted to a country where the actual measurement in the field is tedious or impossible. It was pointed out in the discussion of Mr. Wheeler's paper that the method did not offer great advantages in a country of gentle slopes and rounded outlines, with relatively small differences in elevation, because of the uncertainty of locating the points on different photographs. But when the country possesses no inconvenient features, other methods are easy of application. Moreover, it was urged that the plotting of the points is more laborious than in the older methods of surveying. Mechanical devices based on the theory of perspective can do much to shorten the office work of plotting, and in any case this delay and expense are more than compensated by the rapidity of the field work and the employment of a smaller number of assistants required to remove obstacles in an untravelled country. The method has been employed practically in Canada, where the Topographical Survey has been carried into regions the severe climate of which renders it desirable to shorten as far as possible outdoor operations.

A convenient form of rectifier and interrupter for use with alternating currents is described by Dr. Guilleminot in the *Archives d'Électricité Médicale* for May. The current to be used is led through a vibrating reed, which carries at its free end a contact dipping in and out of a mercury cup. The reed is placed between the poles of a permanent magnet and is magnetised by a coil of wire which surrounds it; the coil is connected (in series with self-induction and resistance) as a shunt to the main circuit. A damping arrangement is also attached to the reed. The reed vibrates in synchronism with the alternating current, and as the contact only dips into the mercury when the reed is deflected downwards, the main circuit is synchronously opened and closed, thus converting the alternating into an intermittent direct current. The great advantage of the apparatus is the ease with which it may be adjusted; the mercury cup can be raised or lowered, thus regulating the time of closed circuit; the length of free reed can be varied, and the phase of the vibration relative to that of the alternating supply can be altered by varying the self-induction in series with the exciting coil. It is thus possible to open the circuit always at the most suitable point of the wave—which depends, of course, on the purpose for which the current is being used. The apparatus, which is said to give excellent results in X-ray work, is the invention of Prof. Villard, and is made by M. Chabaud.

The *Zeitschrift für Elektrochemie* for May 8 contains an interesting article by Dr. A. Ludwig upon the fusion of carbon. After referring to Moissan's classical work on this subject, and to the famous French chemist's production of diamonds in the electric furnace, the author gives details of his own work.

Theoretical reasoning had led him to the belief that, working under sufficient pressure, it would be possible to melt carbon and to maintain it in the liquid condition, and actual experiment verified this theory. At a pressure of 1500 atmospheres, the arc between two carbons inserted in the pressure vessel failed, and not even an E.M.F. of 70 volts sufficed to carry the current across the gap separating them. The author's explanation of this phenomenon is, that the carbon had assumed the third allotropic state, and had in its passage into the liquid and transparent condition become a non-conductor. The difficulty of maintaining it in this condition was, however, great, and in some cases the phenomenon only lasted a few seconds. Attempts were made to obtain diamonds, by sudden cooling of the interior of the pressure vessel by an inrush of water, but although unmistakable diamonds were found amongst the hard grey powder that was obtained, the results were not altogether satisfactory. The apparatus used by the author in these investigations has been patented (English Patent No. 16908, 1900), and as circumstances have compelled him to relinquish his own investigations of the subject, he hopes that others may continue the experiments along the lines he has indicated.

THE development of the large Beaumont oil-field in Texas, which is situated only sixteen miles from the coast, will probably lead to oil being much more largely used as fuel for engines than it has hitherto been. The possibility of a cheaper supply of oil is a matter that is of great importance to this country, and may lead to the increased use of motor cars for suburban traffic and for trade purposes. The oil will be conveyed from the oil-field to the coast by pipe lines, along which the oil will flow by gravity into tank steamers, the cost of conveyance to this country being not much more than a halfpenny a gallon. It has been found by experiment that four and a half barrels of oil, or 189 gallons, are equivalent to one ton of the best coal. Oil is now used largely in America as fuel. On the Southern Pacific Railway 300 engines have been adapted to burn oil, and it is anticipated that a very large sum will, in consequence, be annually saved in the working expenses. In Russia no other fuel than oil is used on the 1600 miles of the Trans-Caspian Railway.

IN the *Proceedings* of the Royal Society of Victoria, of which we have just received part ii. of vol. xiv., 1902, geology dominates, and zoology is the only other science dealt with. The natural history of the country is attracting particular attention, as shown by papers on Crustacea, Polyzoa and Mollusca. Mr. T. S. Hall and Mr. G. B. Pritchard discuss a suggested nomenclature for the marine Tertiary deposits of southern Australia. Local names are always desirable for formations which cannot be expected to correspond in time with the stratigraphical divisions made in distant regions; and the authors are to be commended for using names peculiar to South Australia, despite the fact that they introduce the Werrikooian and Jan Jucian formations. Prof. J. W. Gregory gives an account of the geology of Mount Macedon, an isolated mountain ridge, which though forty miles distant is one of the most conspicuous features in the views from Melbourne. It consists of a volcanic pile resting on Ordovician rocks. The igneous outbursts may have commenced in late Cretaceous times, but there is no certain evidence. The mountain, however, probably marks the beginning of the great period of volcanic activity of which the last eruptions built up still existing craters, and of which records are preserved in the legends of the Victorian aborigines.

THE *Journal* of the Franklin Institute (vol. cliii. No. 1) contains an account of the half-tone trichromatic process of colour-printing, by Mr. F. E. Ives. Until recently, all the finest colour-printing has been done by the chromolithographic process employing from seven to twenty stones with as many inks and impressions. It has long been thought that, in accordance with the trichromatic theory of colour vision, three printing surfaces, colours and impressions might be substituted for the seven to twenty of the lithographer, and that the preparation of these surfaces might be accomplished photographically. The only commercially successful development of this idea at the present time is by the employment of three half-tone process blocks made from a trichromatic negative colour record and printed with three coloured inks in the type process. Up to the present the quality of the product of this process has, however, been so uncertain that the process has been brought somewhat into disrepute. The author shows that conditions can be secured which make it possible to obtain the best results almost automatically.

IN the *Scientific Transactions* of the Royal Dublin Society (vol. vii.) is a paper by Prof. Joly on sedimentation experiments and theories. The rates of settlement of suspensions from solutions containing ions in various degrees of concentration indicate that above a certain concentration the rate of fall of the surface of the suspension is fairly independent of the degree of concentration. Below certain concentrations a distinct surface to the descending suspension fails, and the sediment is only seen to collect from the bottom of the vessel upwards. A suspension precipitated at a concentration in the neighbourhood of this critical concentration does not again precipitate with a distinct surface if reshaken. On removing the electrolyte from such an "exhausted" suspension, it is found that the liquid is as effective as at first in producing surface if a fresh sample of the powder is used. On the other hand, the original powder will not again exhibit the formation of surface when treated with fresh electrolyte of the same strength, but requires a more concentrated solution to do so. The failure is, therefore, to be traced to some alteration in the solid particles, and on testing the fresh powder it is found to be electrically negative towards distilled water, whereas the used powder is neutral or nearly so towards its salt solution. The author advances a theory of the process of sedimentation to account for the observed phenomena.

"THE Pioneers of Evolution, from Thales to Huxley," is the title of a pamphlet of 114 pages by Mr. E. Clodd, published for the Rationalist Press Association by Messrs. Watts and Co.

THE Agricultural Department of the Cape of Good Hope has issued a catalogue of South African fishes (marine and freshwater), drawn up by Dr. J. D. F. Gilchrist, the Government biologist.

IN his report of the Ghizeh Zoological Garden for 1901, Captain Stanley Flower announces that two important additions have been made to the buildings, namely, the lion-house and the elephant-house, both of which were completed during the year.

IN the June number of the *Zoologist* Mr. R. Service alludes to the change which appears to have taken place of late years in the habits of the black-headed gull, this bird being much more of a land-dweller than formerly.

WE have received a copy of a reprint of an article from *Chambers's Journal* in which Mr. H. F. Witherby recapitulates the main facts connected with the migration of birds, adding a few observations made during his own travels in the eastern Sudan and elsewhere.

A SUPPLEMENT to the *Oxford University Gazette*, issued June 17, contains the report of the delegates of the museum for 1901. Among the more important additions to the collections is a "totem-post," about 36 feet in height, from Queen Charlotte Island, presented by Prof. E. B. Tylor. The Hope professor of zoology announces that the insect collection has been very largely increased during the year, the most notable item being a consignment of specimens from Sarawak, presented by Mr. R. Shelford.

THE results of a redetermination of the atomic weight of uranium by Prof. T. W. Richards and Mr. Merigold are published in a recent number of the *Proceedings* of the American Academy of Arts and Sciences. Of previous determinations the only one worthy of serious consideration is that of Zimmermann, who in 1886 found the value 239·59. Zimmermann's method, based on the preparation of pure UO_2 and its conversion into U_3O_8, appears likely to give too high numbers, owing to the difficulty of obtaining the lower oxide free from occluded gases and also of oxidising it completely. After much preliminary work and a long search for suitable substances, Messrs. Richards and Merigold chose the analysis of uranous bromide as the basis of their method. The preparation of pure uranous bromide and its manipulation present considerable difficulties. Its analysis was effected by first oxidising it to uranyl bromide by means of hydrogen peroxide and then precipitating the bromine by means of silver nitrate. The results showed satisfactory concordance, and led to a conclusion expressed by the authors as follows:—"If oxygen be taken as 16·000 and bromine as 79·955, the atomic weight of uranium appears to be not far from 238·53." It is remarked that, although this number differs by more than a unit from that given by Zimmermann, the percentage difference (0·45) is smaller than many which have often been passed unheeded in the case of elements of smaller atomic weight. It is, however, a noteworthy difference, and the probability seems to be that Zimmermann's number was too high. The paper of Messrs. Richards and Merigold brings to light many interesting facts about the chemistry of uranium.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Mr. E. G. Williams; a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by the Rev. E. Millar; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. W. S. Hewitt; a Serval (*Felis serval*) from Africa, presented by Mr. P. Hayton; a Ground Hornbill (*Bucorvus*, sp. inc.) from South Africa, presented by Mr. F. H. O. Wilson; a Senegal Turtle Dove (*Turtur senegalensis*) from West Africa, a White-fronted Dove (*Leptoptila jamaicensis*) from Jamaica, presented by Mr. D. Seth Smith; a Barn Owl (*Strix flammea*) European, presented by Mr. G. Dundas; two West African Pythons (*Python sebae*) from West Africa, presented by Lieut. Lamprey; a Long-nosed Crocodile (*Crocodilus cataphractus*) from West Africa, presented by Capt. Gibson; an Orang-outang (*Simia satyrus*) from Borneo, an Alpine Chamois (*Rupicapra tragus*) from Savoy, a Suricate (*Suricata tetradactyla*), four Cape Crowned Cranes (*Balearica regulorum*) from South Africa, two Grey Ichneumons (*Herpestes griseus*) from India, deposited; a Chimpanzee (*Anthropopithecus troglodytes*) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

July 2. 6h. 27m. to 11h. 22m. Transit of Jupiter's Sat. IV.
2. 14h. 3m. to 14h. 52m. Moon occults δ^3 Tauri (mag. 4·2).
14. Minor planet Vesta in opposition to the sun.
15. Venus. Illuminated disc = 0·807. Mars = 0·979.
15. 10h. Mercury in conjunction with Neptune. Mercury 1° 34′ S.
15. 15h. Mercury at greatest elongation 20° 35′ W.
17. 13h. Saturn in opposition to the sun.
18. 8h. 51m. to 12h. 34m. Transit of Jupiter's Sat. III.
19. Saturn. Outer minor axis of outer ring = 16″·38.
July 19. 10h. 56m. Minimum of Algol (β Persei).
19. 10h. 58m. to 11h. 54m. Moon occults ρ^1 Sagittarii (mag. 3·9).
23. 14h. Mars in conjunction with Neptune. Mars 1° 37′ N.
25. 12h. 9m. to 15h. 51m. Transit of Jupiter's Sat. III.
27. 7h. Venus in conjunction with Neptune. Venus 0° 11′ N.
28. 14h. Venus in conjunction with μ Geminorum. Venus 0° 2′ S.
28–30. Epoch of the Aquarid meteoric shower (radiant 339°–11°).
30. 14h. 46m. to 15h. 28m. Moon occults *m* Tauri (mag. 5·1).
31. 21h. Venus in conjunction with Mars. Venus 1° 18′ S.

THE ANNA BREDIKHINE ASTRONOMICAL PRIZE.—The conditions of this new astronomical prize, founded by Prof. Th. Bredikhine in memory of his wife, are published in *The Observatory* for May. The prize is to be awarded for the most thorough investigations of any large comet, the investigations to be pursued on the lines followed by the donor in his own famous cometary researches.

OCCULTATION OF W LEONIS.—Mr. J. F. Cole, of Cambridge, Mass., writing to *Popular Astronomy* (June, 1902), notes an observed decrease in the magnitude of this variable double about one half-second before its occultation. He suggests that other observers might endeavour to discern the probable change of colour at the next occultation, which takes place at 9h. 21m. (Washington mean time) on July 7, magnitude 5·6, position angle 99°.

A REMARKABLE BOLIDE OBSERVED AT LYONS ON MARCH 19.—A correspondent of the Société Astronomique de France records the appearance of "a magnificent bolide" at 9.10 p.m. on March 19. The observer, who was situated at Lyons, states that the meteor first appeared in the neighbourhood of Arcturus and then travelled eastwards until lost in the haze on the horizon. Form, round; light, yellowish orange; magnitude, brighter than Venus; trail, none; duration, 2 seconds (*Bulletin de la Société Astronomique de France*).

NOTATION OF VARIABLE STARS.—At the suggestion of Mr. A. Stanley Williams, and with the idea of correlating the various notations, a list of eighty-one variables to which different names have been assigned in published lists of variable stars, has been prepared by Mr. H. C. Wilson and published in this month's *Popular Astronomy*.

Of the various systems of notation in vogue, Mr. Wilson favours that used in the *Annuaire*, where the first nine variables discovered in a constellation are named by the last nine letters of the alphabet in their normal sequence; the second nine variables discovered in that constellation are designated in the same way, but the suffix "2" is added to the capital letter, and so on for the third, fourth, &c., sets of nine. Thus the twentieth variable discovered in Sagittarius is catalogued as S^3 Sagittarii. As the author remarks, "This method is capable of indefinite extension without becoming cumbersome; but, unfortunately, it does not have the advantage of priority, nor of adoption by those who are doing the most valuable variable-star work," and he therefore suggests that the double-letter system, as adopted by the Variable Star Committee of the Astronomische Gesellschaft, should be universally used; further, he suggests that the assignment of the notation to individual stars should be left entirely to the Committee, and, for provisional purposes, he advocates the adoption of the notation now used in the *Nachrichten* when naming newly suspected variables, viz. to assign consecutive numbers and to add the year of discovery, *e.g.* 3, 1901.

STUDY OF BRIGHT POINTS AND CURVES.

THE study of "brilliant points and lines" is an application of the principles of geometrical optics which has not hitherto received the amount of consideration which it deserves, when account is taken of (1) the simplicity of the principles involved, (2) the elegance of the results obtained, and (3) the ease with which the subject can be studied experimentally. The writer of the present note has a dim recollection of having worked out in his undergraduate days a tripos rider in which it was required to find the equation of the bright curves seen